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A LOOK AT THE PROBLEM OF DEATH FROM HYPOTHERMIA

on the example of cases of hypothermia-related resuscitations

ABSTRACT

In the Far North, one of the main environmental risk factors is the cold, which lasts for 8 months. The problem of the effect of cold on the human body has always been and remains relevant. Annually, about 3,000 people around the world are frozen to death, of which about 200 cases take place in Yakutia.

The article describes a unique case of resuscitation of a frozen patient, which gives grounds to revise algorithm of actions in relation to frozen patients, both from medical and legal points of view.

Keywords: general hypothermia, frozen person, death from hypothermia, case of resuscitation.

In the Far North, one of the main environmental risk factors is the cold, which lasts for 8 months. The problem of the effect of cold on the human body has always been and remains relevant. Annually, about 3,000 people around the world are frozen to death, of which about 200 - in Yakutia.

Despite the harsh climate, indigenous peoples of the Far North are able to feel relatively comfortable here, because of innate resistance. However, under the influence of socio-economic factors (long distances between settlements, alcohol intoxications, prolonged staying outside without suitable clothes, traumas that do not allow them to move and keep warm),

both the indigenous and the foreign populations die from the cold. Death from the effects of cold is usually the result of an accident. Suicide by hypothermia is extremely rare [1].

Men of working age die more often from the effects of cold. Less often people die sober from hypothermia, among others – exhausted during a blizzard or lost in the forest. According to statistics in Yakutia every year (on average) 200 people die from general hypothermia. In the Republic, cases of resuscitation of "firmly" frozen people in recorded medicine are extremely rare. Thus, according to Professor R.Z. Alekseev, engaged in cold trauma, in his

50 yrs practice there were only 2 cases when a frozen man and child came back to life after thawing in morgue.

At the same time, there are many examples in scientific literature where people who had seemed dead from hypothermia revived and were brought back to life. In all these cases, they were healthy and fairly young people who froze; this was the main factor that contributed to the resuscitation from the frozen state. However, until now there are no scientifically sound methods for revitalizing frozen people globally.

According to some Internet sources, the most effective way to revitalize frozen people is to warm the body using living

person's heat. During World War II, the command of the German naval forces instructed military doctors to find the most effective way of resuscitation of people affected by hypothermia. A lot of medicinal and other ways of reviving on war prisoners were tried out. The best way was recognized to be... street prostitutes, who with their naked bodies resuscitated frozen men much faster than all other means. They brought back to life those who could not be reanimated by any other means [3].

A unique case of the revitalization of a "firmly" frozen man occurred in 1996 in a village in Verkhnevilyuisky Ulus, which was noted in the newspaper "Uehee Buluu" dated November 19th, 1996. Patient A., 37, on the evening of March 25th, 1996 after drinking alcoholic drinks with friends in the evening went home by motorcycle. The next morning at 6 am he was found by fellow villagers outside the village in the snow. According to eyewitnesses, when he was found, he was without clothes glaciated in a pose of "man, warming himself by the fire," with arms and legs extended and without any signs of life. The outer temperature was 37° below zero. In this form, he was immediately taken to the district hospital, where, fortunately, at that time, Nadezhda Vasilievna Mikhaylova (Brusenina), a doctor from Yakutsk, had her shift at the hospital. According to the description of N.V. Mikhailova, the frozen man was unconscious, the skin had marble-white colors, the eyes were open, but the tip of the tongue protruded from the corner of the mouth, the pulse could not be felt, the arms and legs seemed "wooden", stretched out in the posture above described. The victim had frozen traces of urination on his back, traces of violence on the body were not found. The doctor was shocked by the picture she saw, but did not lose her head, and began to resuscitate the patient. For almost 12 hours – from 7 am to 7 pm, N.V. Mikhailova was warming the frozen body with her own hands, warming them over the flame of a candle. Simultaneously, she orally gave a teaspoonful of vodka during the day, and also rubbed the victim's body. All this time, the victim was lying on the floor, where the temperature was just below room temperature (presumably +18°C). After the body has softened, arms and legs have relaxed, he was laid on a bed and covered with blankets. After some time, the patient suffered a severe shivering fit. At midnight patient A. came back to sense without resuscitation and

could answer questions. The first portion of his urine was bloody. After taking hot tea and broth, after a few hours, urine recovered and acquired a normal color. The next morning, the "resuscitated" patient A. went home. N.V. Mikhailova managed to save not only all the fingers and toes, but miraculously restore all internal organs. Saved from certain death, patient A. still lives and works in his home village in Verkhnevilyuisky Ulus.

According to some observations, when the temperature of the body drops by just one degree, coordination and motor skills deteriorate and a certain muscle tone appears that precedes jitters. The receptors send a signal to the center of thermoregulation about reduction of all surface capillaries. Hands and feet begin to ache from the cold. When the body temperature reaches 35° C, the state of mild hypothermia develops, the person feels a strong tremor, in which the muscles quickly contract to produce additional heat. And when the body temperature drops to 31.1° C, it refuses to try to warm itself up by trembling, the body ceases to produce heat. The blood thickens like motor oil in a cooled engine. Consumption of oxygen decreases by more than a quarter. However, the kidneys work in a strengthened mode to cope with the hypervolemia that arose at the time when the blood vessels of the limbs contracted and pushed the fluid toward the center of the body. In this case, a person feels a powerful urge to urinate. At a temperature of 30°C, the heart begins to beat arrhythmically and can only distil two-thirds of the normal blood volume. Lack of oxygen and a decrease in the rate of brain metabolism, meanwhile, lead to visual and auditory hallucinations. At a temperature of 29.4°C, freezing people begin to rip off their clothes in a strange agonizing bout. Scientists have not yet agreed on phenomenon causes, the most logical explanation for it may be that shortly before complete loss of consciousness, the narrowed blood vessels located near the surface of the skin suddenly expand, which causes a feeling of intense heat on the skin. At 20°C, the heart stops. At air temperature of 35°C below zero the body temperature drops by an average of one degree every 30-40 minutes [3].

In the presented case, patient A. was on the street at an air temperature of 37°C below zero not less than 9 hours in a state of alcohol intoxication. Thus, the temperature of his body could have reached about 23°C, as evidenced

by involuntary urination and tearing off his clothes during a hallucination. And the presence of alcohol in the body exacerbated the situation. With alcohol intoxication in cold conditions, metabolic processes are slowed down and the reflex of muscular tremor is blocked, which leads to a decrease in heat production, due to a slowdown in the oxidation of fat and carbohydrate stores. Heat transfer is faster (even despite active oxidation of ethanol as heat energy) than heat formation, which leads to a negative balance of the overall body temperature and its rapid decrease. People die in the cold under the influence of alcohol, without realizing and taking measures to save themselves even with rapid sobering [2, 5].

In experiments on mice, injected with alcohol, after it they were placed in a box with thawed snow, it was found that they died 5 times faster than mice without alcohol. It was also found that the higher the dose of alcohol administered, the faster the death [1].

In fact, according to Professor R.Z. Alekseyev, many victims of hypothermia die more often at the very moment when they are being resuscitated. Traditional ways of saving hands and feet with severe cold damage - intense massage, flexion-extension, and abrupt placement of the patient in a warm or hot bath - do not help, but on the contrary, do harm. At a sudden warming, the narrowed capillaries expand all at once, which leads to a sharp drop in pressure. The slightest movement can provoke strong spasms of the heart muscle of the victim. At extremely low temperatures, the human body is doing its best to preserve itself, greatly slowing down internal processes. Many people found with hypothermia seem dead only at first glance. The body can survive in this state for hours, and resuscitation process must be gradual, precise, and very careful.

However, those who are familiar with frost effects know that, although the cold deprives organisms of their vital energy, it can also grant chance for life's preservation. Heat is a presence – intense vibration of molecules. Cold is an absence – a slowing down of vibrations. At absolute zero, the motion of the molecules completely ceases. It is this retardation that allows gases to turn into liquid, and liquids into solids. It slows the growth rate of bacteria and chemical reactions. In the human body, the cold stops metabolism. The lungs receive less oxygen; the heart pumps less blood.

At normal temperature, this can cause irreversible brain damage. But a frozen brain, whose metabolism also slows down, needs much less oxygenated blood and under certain circumstances can remain intact.

The slowing down of all processes that accompanies freezing is in ways so useful that sometimes it is even artificially reproduced. Nowadays, cardiologists often use severe hypothermia to slow the metabolism of their patient in preparation for surgical operations on the brain or heart. In this state, the patient's blood flows very slowly, and the heart does not beat very much, and with CPB – stops beating completely. With states like those, death seems to be inevitable. However, under close supervision, the patient may be in a state of hypothermia without harming one's health.

American researcher Mark B. Roth from the Fred Hutchinson Cancer Research Center in Seattle, Washington, studied the effect of cold on garden worm embryos as they turned into full-fledged young worms. The researcher noticed that when exposed only to freezing temperatures, embryos of worms died and after warming did not restore cell division. But after first depriving them of oxygen and later freezing, the embryo still stopped cell division due to lack of oxygen, there is a sudden stop of

chemical reactions in the body. After 2.5 hours later the oxygen supply was restored and the cell division resumed unchanged. Thus, Mark Roth noted the connection between low temperature and low oxygen content, which can lead to a method of prolonging preservation time of human organs for transplantation [6].

In conclusion one can say that this unique case of resuscitation of a frozen person gives grounds to review many questions in the actions towards hypothermia cases, both from medical and legal points of view. In the USA, frozen people are declared dead only after unsuccessful attempts to warm them up and provide aid. Meanwhile in Russia frozen people are delivered straight to the morgue, where, they, naturally, do not receive help. In this case, patient A. was lucky that doctor N.V. Mikhailova was at the right place at the right time, who did not hesitate and thawed the frozen body, thereby successfully bringing the patient back to life.

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